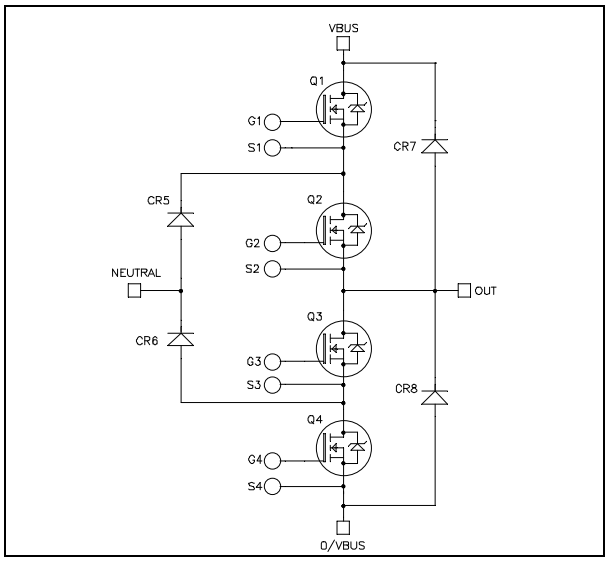
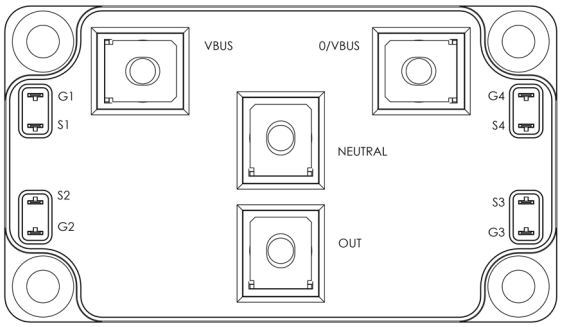
Three level inverter SiC MOSFET Power Module

***SiC Power MOSFET* :**
V_{DSS} = 1200V ; R_{DSon} = 12mΩ @ Tj = 25°C





Application

- Uninterruptible Power Supplies

Features

- ***SiC Power MOSFET***
  - Low $R_{DS(on)}$
  - High temperature performance
- ***SiC Schottky Diode***
  - Zero reverse recovery
  - Zero forward recovery
  - Temperature Independent switching behavior
  - Positive temperature coefficient on VF
- Kelvin emitter for easy drive
- Very low stray inductance
- M5 power connectors
- High level of integration
- AlN substrate for improved thermal performance

Benefits

- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Easy paralleling due to positive TC of VCEsat
- Low profile
- RoHS Compliant

All ratings @ T_j = 25°C unless otherwise specified

Q1 to Q4 Absolute maximum ratings (per SiC MOSFET)

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{DSS}	Drain - Source Voltage		1200	V
I_D	Continuous Drain Current	T_c = 25°C	219	A
		T_c = 80°C	164	
I_{DM}	Pulsed Drain current		440	
V_{GS}	Gate - Source Voltage		-10/+25	V
R_{DSon}	Drain - Source ON Resistance		12	mΩ
P_D	Maximum Power Dissipation	T_c = 25°C	925	W

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.
See application note APT0502 on www.microsemi.com

Q1 to Q4 Electrical Characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	V_{GS} = 0V ; V_{DS} = 1200V				300	µA
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 20V I_D = 150A	T_j = 25°C		8	12	mΩ
			T_j = 150°C		14	21	
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 30mA		2.1	2.4		V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = 20 V, V_{DS} = 0V				1.8	µA

Q1 to Q4 Dynamic Characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{GS} = 0V V_{DS} = 1000V f = 1MHz			8.4		nF
C_{oss}	Output Capacitance				0.66		
C_{rss}	Reverse Transfer Capacitance				0.045		
Q_g	Total gate Charge	V_{GS} = -5/+20V V_{Bus} = 800V I_D = 150A			483		nC
Q_{gs}	Gate – Source Charge				138		
Q_{gd}	Gate – Drain Charge				150		
$T_{d(on)}$	Turn-on Delay Time	V_{GS} = -5/+20V V_{Bus} = 800V I_D=150A , T_J=150°C R_L = 5.3Ω ; R_{Gext} = 6.7Ω			35		ns
T_r	Rise Time				40		
$T_{d(off)}$	Turn-off Delay Time				150		
T_f	Fall Time				70		
E_{on}	Turn on Energy	Inductive Switching V_{GS} = -5/+20V V_{Bus} = 600V I_D = 150A R_{Gext} = 6.7Ω	T_j = 150°C		3.3		mJ
E_{off}	Turn off Energy		T_j = 150°C		1.8		mJ
R_{thJC}	Junction to Case Thermal Resistance					0.135	°C/W

Body diode ratings and characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V_{SD}	Diode Forward Voltage	V_{GS} = -5V, I_{SD} = 75A		3.3		V
		V_{GS} = -2V, I_{SD} = 75A		3.1		
t_{rr}	Reverse Recovery Time	I_{SD} = 150A ; V_{GS} = -5V V_R = 800V ; di_F/dt = 3000A/µs		45		ns
Q_{rr}	Reverse Recovery Charge			1.2		µC
I_{rr}	Reverse Recovery Current			40		A

CR5 & CR6 SiC diode ratings and characteristics (Per SiC diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Peak Repetitive Reverse Voltage					600	V
I_{RM}	Reverse Leakage Current	V_R=600V	T_j = 25°C		220	1320	µA
			T_j = 175°C		440	6600	
I_F	DC Forward Current		Tc = 125°C		220		A
V_F	Diode Forward Voltage	I_F = 220A	T_j = 25°C		1.6	1.8	V
			T_j = 175°C		2	2.4	
Q_C	Total Capacitive Charge	I_F = 220A, V_R = 600V di/dt =5000A/µs			616		nC
C	Total Capacitance	f = 1MHz, V_R = 200V			1430		pF
		f = 1MHz, V_R = 400V			1100		
R_{thJC}	Junction to Case Thermal Resistance					0.1	°C/W

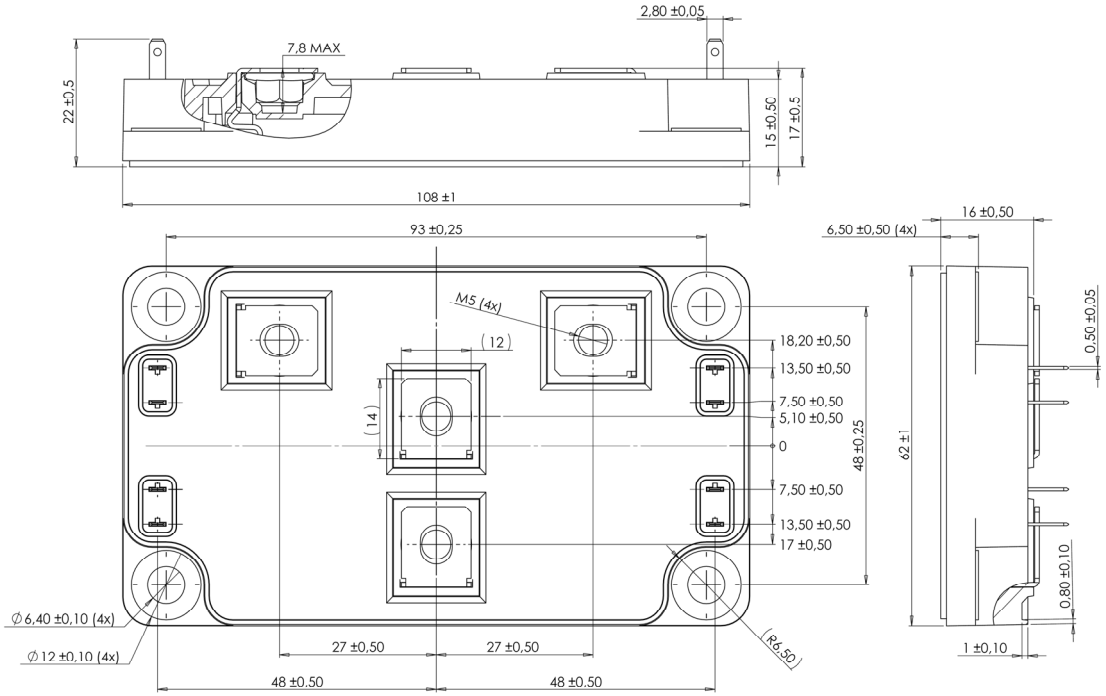
CR7 & CR8 diode ratings and characteristics (Per SiC diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Peak Repetitive Reverse Voltage					1200	V
I_{RM}	Reverse Leakage Current	V_R=1200V	T_j = 25°C		280	1600	µA
			T_j = 175°C		520	3200	
I_F	DC Forward Current		Tc = 125°C		160		A
V_F	Diode Forward Voltage	I_F = 160A	T_j = 25°C		1.5	1.8	V
			T_j = 175°C		2.2	3	
Q_C	Total Capacitive Charge	I_F = 160A, V_R = 1200V di/dt =4000A/µs			1040		nC
C	Total Capacitance	f = 1MHz, V_R = 400V			744		pF
		f = 1MHz, V_R = 800V			536		
R_{thJC}	Junction to Case Thermal Resistance					0.14	°C/W

Thermal and package characteristics

Symbol	Characteristic			Min	Max	Unit
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz			4000		V
T_J	Operating junction temperature range	SiC MOSFET		-40	150	°C
		SiC diode		-40	175	
T_{JOP}	Recommended junction temperature under switching conditions			-40	$T_J$max -25	
T_{STG}	Storage Temperature Range			-40	125	
T_C	Operating Case Temperature			-40	125	
Torque	Mounting torque	To heatsink	M6	3	5	N.m
		For terminals	M5	2	3.5	
Wt	Package Weight				300	g

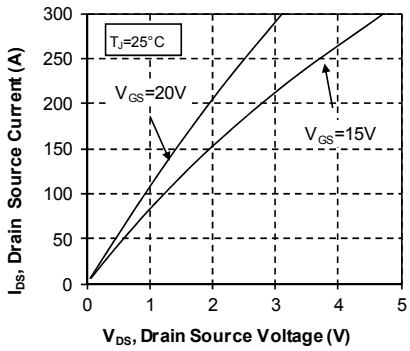
SP6 Package outline (dimensions in mm)



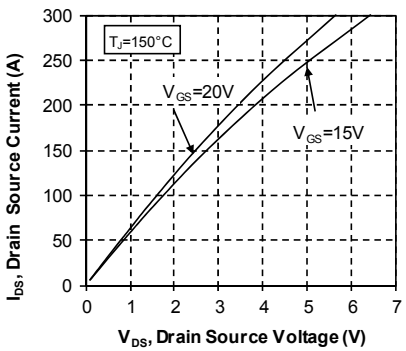
See application note APT0601 - Mounting Instructions for SP6 Power Modules on www.microsemi.com

Q1 to Q4 Typical performance curve

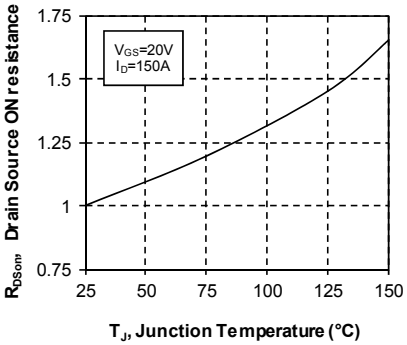
Output Characteristics



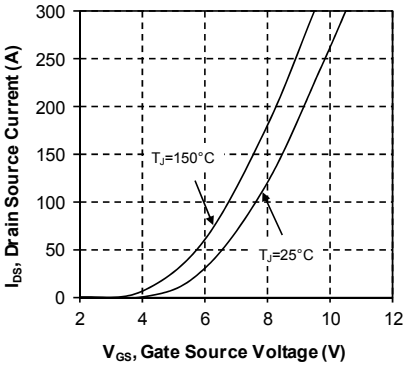
Output Characteristics



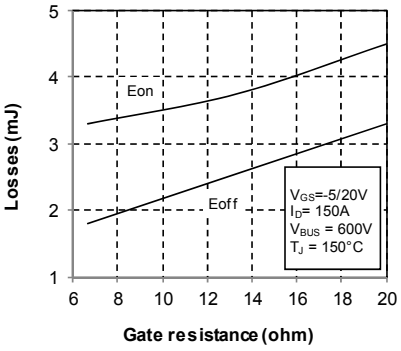
Normalized $R_{DS(on)}$ vs. Temperature



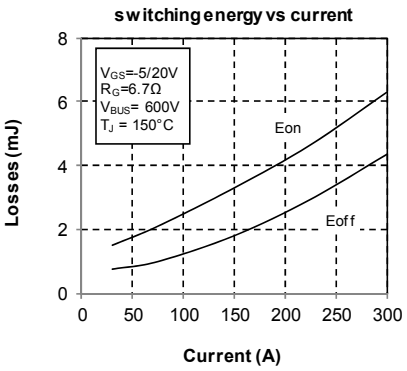
Transfert Characteristics



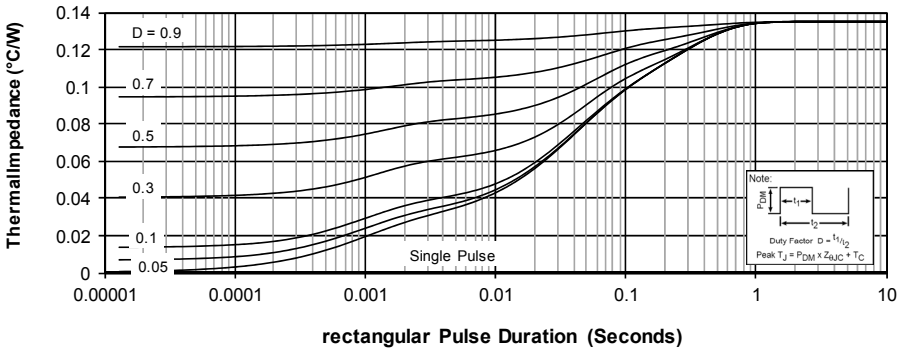
Switching energy vs Rg



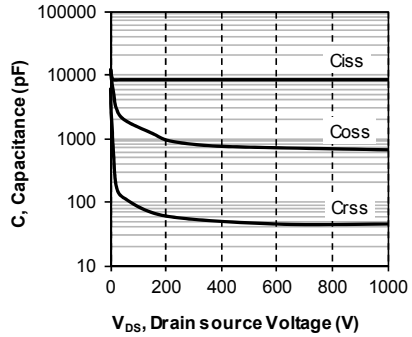
switching energy vs current



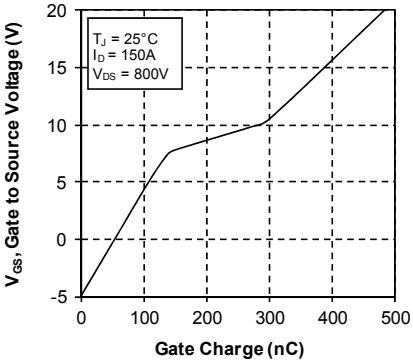
Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration



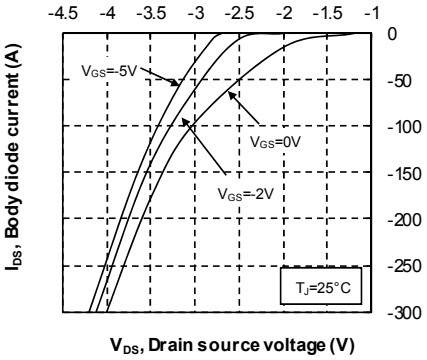
Capacitance vs Drain Source Voltage



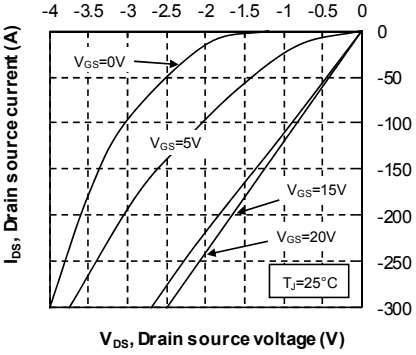
Gate Charge vs Gate Source Voltage



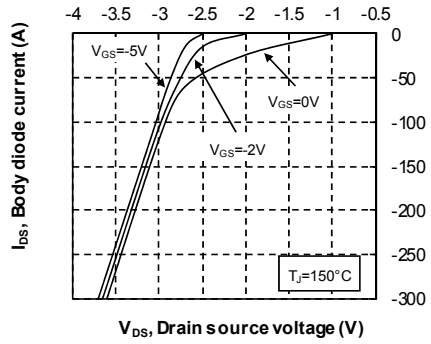
Body diode Characteristics



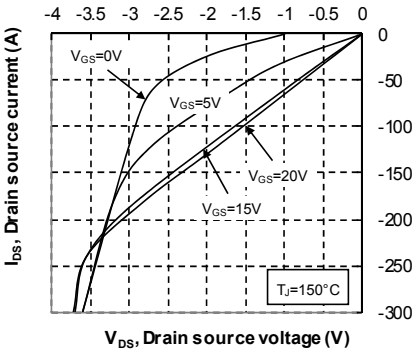
3rd quadran Characteristics



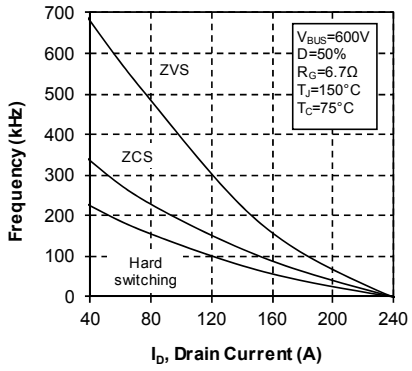
Body diode Characteristics



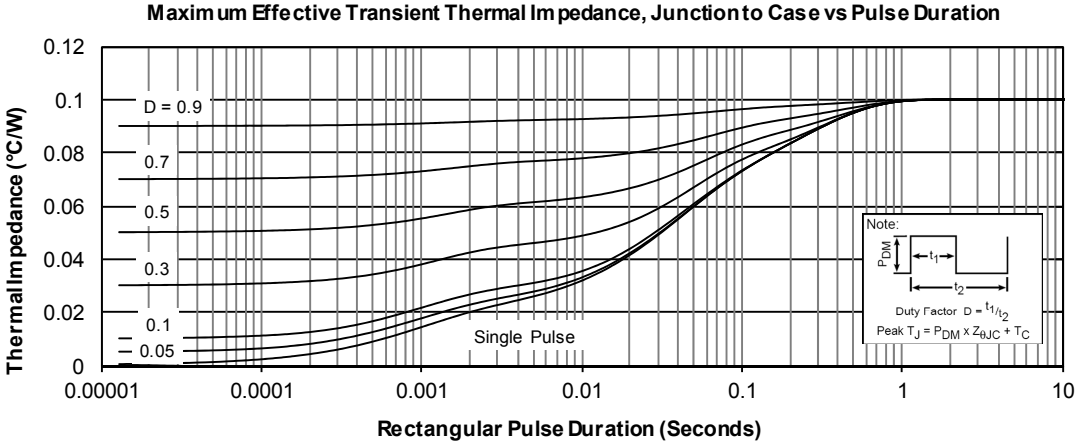
3 rd quadran Characteristics

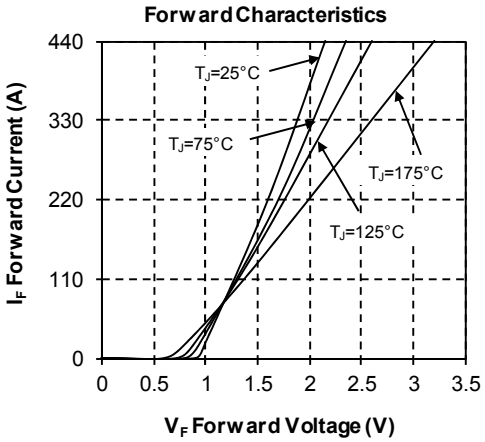


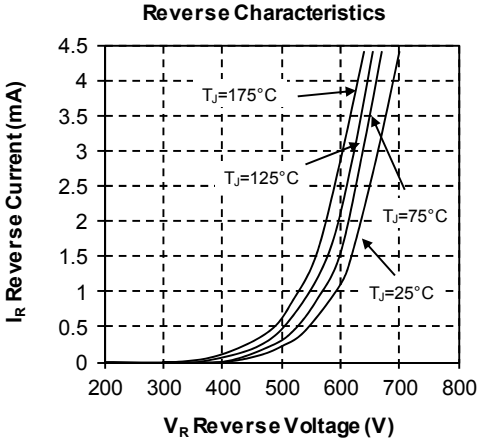
Operating Frequency vs Drain Current

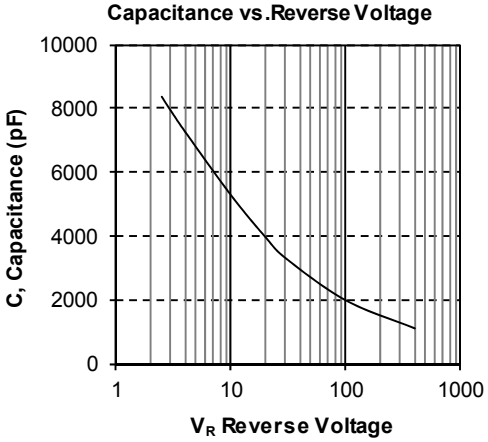


CR5 & CR6 Typical performance curve

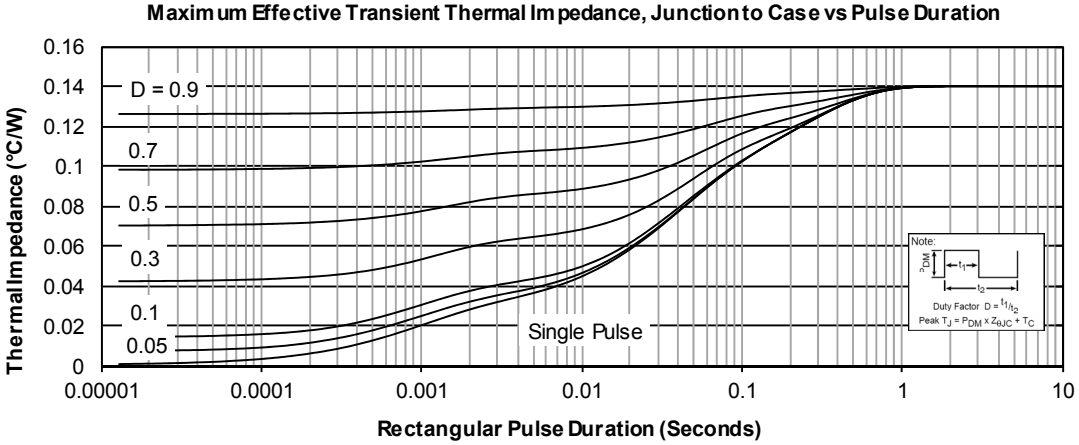


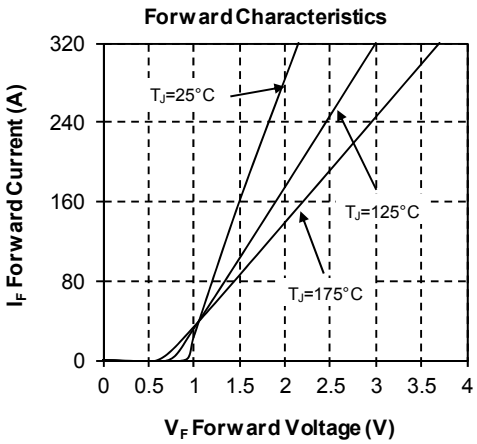


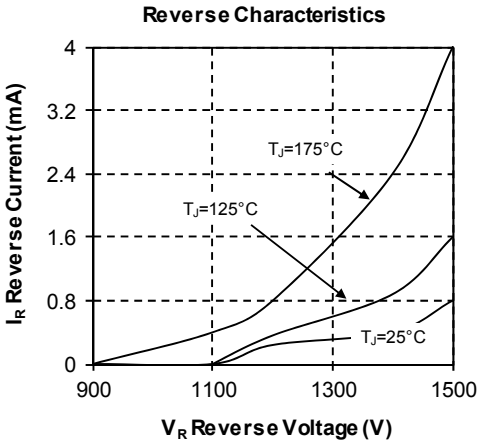


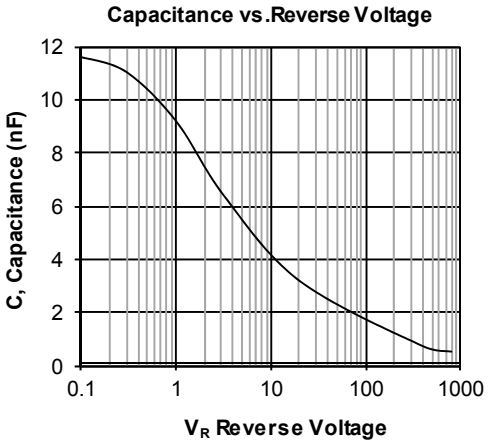


CR7 & CR8 Typical performance curve









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